Web service for reproducible multidisciplinary data visualization

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Summary. We propose a new method for reproducible data visualization on a web browser. A web service, Cross-Cutting Comparisons (C3) has a query string (QS)-controllable system to make various interactive charts of earth, planetary and space sciences. By including information of data handling procedures in the QS in an orderly manner, the chart is easy to understand, remake and share via text-based communication tools.

Keywords. reproducibility, data visualization, geoscience, web service, cross-cutting research.

1. Introduction

Reproducibility is one of the foundations of the scientific method. Reproducible evidence is imperative to build new scientific knowledge. Since most natural scientists use figures, graphs, plots or diagrams (hereinafter collectively called charts) to understand a phenomenon in detail, reproducible charts are needed to promote scientific development. However, it is not easy especially for studies dealing with scientific data of different fields.

For this reason, we have been building a web service, Cross-Cutting Comparisons (C3) (https://darts.isas.jaxa.jp/C3/; [1]), to provide reproducible charts of earth, planetary and space sciences.

2. Data-flow design

C3 is an application of Data ARchives and Transmission System (DARTS) [2-3]. It consists of data and web servers. The data server currently stores opened data sets of the fields in earth, planetary and space sciences. The web server mediates between a client and the data server.

To handle a large number of requests from users, C3 checks the inputted setting and dynamically creates a query string (QS) on the client side. Then, the web server executes data handling procedures according to the client's requests.

3. Multidisciplinary data visualization

To capture the feature of various phenomena such as long-term variations or sudden events of earth, planetary and space sciences, it is necessary to examine scientific data by flexibly changing the time and space scales. C3 uses HTML and JavaScript libraries to visualize multidisciplinary data on a web browser.

Figure 1 shows examples of the charts: (a) is time series of total solar irradiance from the Solar Radiation and Climate Experiment (SORCE) [4], (b) is an altitude profile of temperature from the Atmospheric Chemistry Experiment-Fourier Transform Spectrometer (ACE-FTS) [5], (c) is a global map of ozone from the Superconducting Submillimeter-Wave Limb-Emission Sounder (SMILES) [6], and (d) is a focal depth from the United States Geological Survey (USGS) (https://www.usgs.gov/).

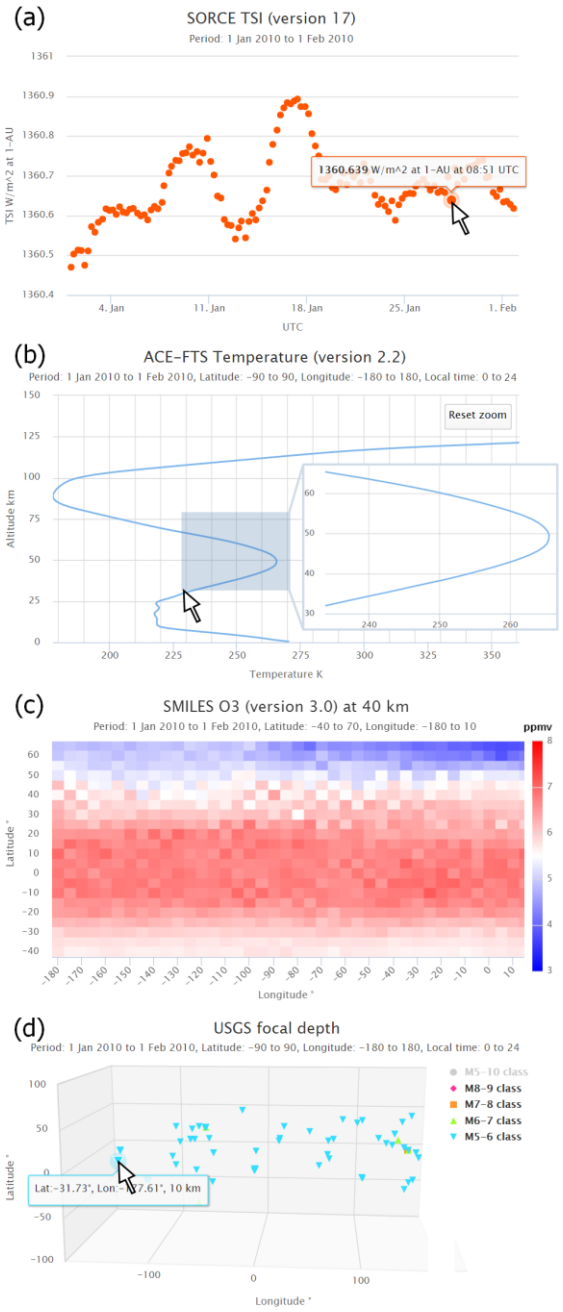

Figure 1 Examples of the interactive charts
(a): total solar irradiance (TSI) (b): altitude profile of temperature, (c): global map of ozone, (d): focal depth

4. Approach of reproducibility

All the charts showed in Figure 1 have a QS in an address bar. The structure of the QS of C3 is as follow:

header+selection+extraction+(analytic method).

The QS consists of three parts separated by plusses (+): header, selection and extraction. The header part includes information of language of the chart and the system version of C3 (default is the latest version), the selection part has information of metadata and figure type. The information of data extraction (e.g., time period, location and altitude) is described in the extraction part. Another part of data analysis (e.g., averaging, least square, correlation coefficient, size of mesh grid or a combination of these analyses) will be added to the QS in the next version of C3.

5. Conclusions

C3 has a QS-controllable system to make various interactive charts. By explicitly showing the inputted setting in an orderly manner in the QS, it is easy to understand how the chart is made. User can easily review the previous work, quickly access to the charts, and also reduce an amount of data. Our new approach making charts by a QS has the possibility to promote scientific development in the forthcoming epoch of Open Data.

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